



Published in final edited form as:

J Dent Educ. 2013 May ; 77(5): 581–590.

Oral Health Education for Pediatric Nurse Practitioner Students

Jay Golinveaux, D.D.S., M.S., Barbara Gerbert, Ph.D., Jing Cheng, Ph.D., Karen Duderstadt, R.N., Ph.D., C.P.N.P., P.C.N.S., Abbey Alkon, R.N., P.N.P., Ph.D., Shirin Mullen, D.D.S., Brent Lin, D.M.D., Arthur Miller, Ph.D., and Ling Zhan, D.D.S., Ph.D.

Dr. Golinveaux is a Pediatric Dentist in San Francisco, CA; Dr. Gerbert is Professor Emeritus, Department of Preventive and Restorative Dental Sciences, School of Dentistry, University of California, San Francisco; Dr. Cheng is Associate Professor, Center to Address Disparities in Children's Oral Health, Department of Preventive and Restorative Dental Sciences, School of Dentistry, University of California, San Francisco; Dr. Duderstadt is Clinical Professor, Department of Family Health Care Nursing, School of Nursing, University of California, San Francisco; Dr. Alkon is Professor, School of Nursing, University of California, San Francisco and Director, California Childcare Health Program; Dr. Mullen is a Pediatric Resident, Division of Pediatric Dentistry, School of Dentistry, University of California, San Francisco; Dr. Lin is Clinical Professor, Division of Pediatric Dentistry, School of Dentistry, University of California, San Francisco; Dr. Miller is Professor, Department of Orofacial Sciences, School of Dentistry, University of California, San Francisco; and Dr. Zhan is Assistant Professor, Department of Preventive and Restorative Dental Sciences, School of Dentistry, University of California, San Francisco

Abstract

The aim of this study was to evaluate whether an interdisciplinary, multifaceted oral health education program delivered to pediatric nurse practitioner students at the University of California, San Francisco, would improve their knowledge, confidence, attitudes, and behaviors regarding the provision of oral health assessments, consultations, referrals, and services to young children during well-child visits. Thirty pediatric nurse practitioner students were included in the study. Participants completed a written survey before and after receiving an interdisciplinary educational intervention that included didactic education, simulation exercises, and clinical observation by a pediatric dental resident. Between pre-intervention and post-intervention, a significant improvement was seen in the pediatric nurse practitioners' knowledge of oral health topics ($p < 0.001$), confidence when providing oral health counseling ($p < 0.001$), and attitudes about including oral health counseling in their examinations ($p = 0.006$). In the post-intervention survey, 83 percent of the subjects reported having incorporated oral examinations into their well-child visits. Our study suggests that providing an interdisciplinary oral health educational program for pediatric nurse practitioner students can improve their knowledge, confidence, attitudes, and behaviors regarding the incorporation of oral health care services during routine well-child visits.

Keywords

oral health education; pediatric nurse practitioner students; interdisciplinary education; interprofessional education; well-child visits

Dental caries is the most prevalent chronic disease in children in the United States today.^{1,2} Caries prevention is especially challenging for children aged two to five years, which is the only age group that displayed an increased caries prevalence between the periods 1988–94 and 1999–2000 in the National Health and Nutrition Examination Survey.¹ Furthermore, the caries distribution is skewed since 80 percent of tooth decay is found in 25 percent of children, large numbers of whom live in low-income households and lack access to dental care.² The incidence of untreated dental caries is high in these children and can have significant adverse effects on their systemic health as well as impact their ability to eat, speak, and learn.^{1,2} It has also been reported that 1.6 million school days are missed annually for reasons related to dental decay.³

Dental caries is a transmissible infectious disease, and early prevention service to combat it can provide a lifelong benefit to children's oral health. Caries can develop in children as early as ten months of age, and by three years, 25 percent of children enrolled in the Women, Infants, and Children (WIC) program have developed caries.⁴ However, early intervention, such as maternal use of xylitol gums at infancy, has significantly reduced caries-causing bacteria colonization and caries in children up to age ten.^{5,6} Children who had had early preventive dental visits or counseling had significantly fewer caries lesions and dental expenses than those who had not received them.^{7–10} Therefore, providing early prevention and oral health care services is critical for promotion of children's oral health.

Although the American Association of Pediatric Dentistry recommends that all infants have established dental homes by age one,¹¹ many children do not have a dental home by that age. Recent studies reported that only 2 percent of children had had a dental visit by age one.^{12–15} The incidence increased to 11 percent by age two and to 26 percent by age three.¹⁴ The average age of a child at his or her first dental visit was four years in the United States.^{12–15} Factors contributing to the low rate of access to oral health care in young children include a shortage and maldistribution of dentists, especially those who treat Medicaid or State Children's Health Insurance Program (SCHIP) recipients; cultural and societal barriers; and parents' limited English proficiency and lack of health literacy. These barriers are especially predominant in children with disparities who live in low socioeconomic conditions or are recent immigrants.^{16–19}

In contrast, most infants have a well-established medical home at an early stage of life.^{15,20} Therefore, nondental primary care providers (such as family physicians, pediatricians, physician assistants, and nurse practitioners) are in a unique position to play a role in promoting oral health in young children and to compensate for the shortage of dentists. The American Academy of Pediatrics (AAP) recommends that children have a minimum of seven routine visits to their pediatric primary care providers in the first years of life. These visits can provide a valuable opportunity for pediatric primary care providers to perform basic oral health assessments and prevention service, to provide oral health care guidance to

parents of infants, and to refer infants, especially those at high risk, to dentists for early oral preventive care.

Pediatric nurse practitioners have been an important component of pediatric primary care provision since the 1960s, the beginning of a nationwide shortage of pediatricians that continues today.²¹ Currently, there are approximately 100 pediatric nurse practitioner educational programs in the United States.²² As vital pediatric primary care providers, pediatric nurse practitioners are uniquely positioned to play a significant role in the promotion of oral health in children.

Although studies have shown that incorporating caries prevention into pediatric well-child visits significantly improves infants' access to oral preventive services and reduces their caries prevalence,^{8,10} recent studies have also shown that pediatric primary care providers and pediatric nurse practitioners lack competence in performing oral health assessments and providing counseling for children.^{23–26} These results indicate that pediatric health care providers need additional oral health education.

However, limited research has been done on incorporating oral health education into pediatric nurse practitioner educational programs although a few studies have investigated oral health education programs aimed at improving pediatric primary care providers' knowledge of, attitudes toward, and behaviors concerning oral health examinations.^{19,26–28} Adding an interdisciplinary oral health educational intervention to an existing program is feasible and may encourage pediatric nurse practitioners to provide oral health consultations, preventive treatments, and referrals for children during well-child visits. The aim of this study was to evaluate whether oral health education—which would include didactic education, simulation exercises, and clinical observation of a pediatric dentist—delivered to pediatric nurse practitioner students at the University of California, San Francisco (UCSF) would improve their knowledge, confidence, attitudes, and behaviors regarding the provision of oral health assessments, consultations, preventive treatments, and referrals for young children during well-child visits.

Materials and Methods

The study was approved by the UCSF Committee on Human Research (Approval #H68200–35300–01). All of the first-year students enrolled in the pediatric nurse practitioner program at UCSF were recruited to participate in an interdisciplinary, multifaceted oral health educational intervention in 2009. A written consent form was obtained from each subject. This intervention was incorporated as part of the students' preclinical and clinical educational curriculum. A written survey was administered before and five to nine months after the completion of the educational intervention. The survey assessed these students' knowledge of oral health topics as well as their confidence, attitudes toward, and behaviors of providing oral health services. The changes in their knowledge, confidence, attitudes, and behaviors on providing oral health services were compared before and after the intervention.

The study participants were enrolled in a two-year pediatric nurse practitioner program that includes six months of didactic education followed by eighteen months of both didactic and clinical education. These students had been registered nurses before beginning the program.

The interdisciplinary, multifaceted educational intervention included three components. First, a one-hour lecture developed by pediatric nurse practitioner faculty members based on the First Smiles and AAP curricula was given.^{29,30} A week later, a one-hour skills simulation exercise was administered to reinforce the topics presented in the lecture. The skills simulation included short videos available on the AAP website that provided basic instruction in examining children and applying fluoride varnish.³¹ The participants then practiced examination techniques and applied fluoride varnish on each other's teeth.

The third component was a half-day observation session at the UCSF Pediatric Dentistry Clinic as part of the students' clinical rotations; this was supervised by a pediatric dental resident (author Golinveaux). The observation began with a review and question-and-answer session on previously covered oral health topics. The students next observed regular oral examinations and dental treatments of children up to three years of age. Some participants performed dental examinations and applied fluoride varnish on these children's teeth.

Each participant completed the pre-intervention survey in November 2009 and a follow-up survey in October 2010. Their clinical practice session began in January 2010. All participants completed the three components of oral health education intervention between January and May 2010. The pre-intervention and the post-intervention surveys were identical except that on the post-intervention survey the respondents were asked to explain their reasons for not providing a specific service. The survey had four sections: demographics, knowledge, confidence and attitudes, and behaviors. The questions were adapted from survey instruments that had been used in previously published studies on oral health interventions directed at primary care providers.^{27,28} Each participant's survey was assigned a random identifier, and the data were analyzed anonymously.

Descriptive statistics, including means and standard deviations for the sum of scores in each domain, frequencies and proportions for categorical demographic variables, and individual scores for questions, were used to summarize the demographics of the participants and their survey responses for knowledge, confidence, attitudes, and behaviors before and after receiving the education. In the oral health knowledge section, one score was given for each question answered correctly, and a score of 0 was assigned for each one answered incorrectly. In the confidence section, answers were scored as 0 for not confident, 1 for somewhat confident, and 2 for very confident. In the attitudes section, answers were scored as 0 for strongly disagree, 1 for disagree, 2 for agree, and 3 for strongly agree. In the behavior section, answers were scored as 0 for a response of 0–10 or never, 1 for a response of 11–20 or rarely, 2 for a response of 21–30 or occasionally, 3 for a response of 31–40 or frequently, and 4 for a response of >40 or always.

A Wilcoxon signed-rank test was used to determine whether there had been an overall change in the sum of each participant's scores in each section (confidence, attitude, behavior) after she or he had received the education. In order to investigate any change in

responses to the individual questions after the education, the exact McNemar's test³² was used for dichotomous response in the knowledge section; the marginal homogeneity over the multiple categories of response before and after the education was tested with the Bhapkar test³³ in the confidence, attitude, and behavior sections.

Results

A total of thirty-one students were enrolled in the study. Thirty students completed both the pre-intervention and post-intervention surveys as well as all of the components of the intervention. One subject failed to complete the baseline survey and was excluded from the analysis.

The subjects' demographic data are shown in Table 1. Sixty percent of the participants were between the ages of twenty-six and thirty, and 93 percent were female. Most participants had between one and six years of prior nurse experience. Seventeen (57 percent) of the subjects reported a preference for working in primary care clinical settings after graduation, and the remaining reported a preference for working in a hospital or specialty clinic. Only six (20 percent) stated that they had received oral health education before participating in the study.

Oral Health Knowledge

Measures of the participants' oral health knowledge before and after the intervention are shown in Table 2. After the intervention, a significant improvement was seen in the subjects' overall knowledge of oral health topics (mean [median] sum of scores=8.9 (9.0) and 10.4 (10.0), respectively, before and after the intervention; Wilcoxon signed-rank test, $p<0.001$).

In the post-intervention survey, eight questions were answered correctly by more than 85 percent of the participants. Specifically, 100 percent of the subjects answered the question on reimbursement for fluoride varnish treatment by non-dental health care professionals correctly, demonstrating a significant improvement over their pre-intervention responses (63 percent) (exact McNemar's test, $p=0.003$). However, only between 33 and 57 percent of the subjects correctly answered the questions regarding the systemic effect of fluoride, fluoride use for children under age three, age of a child's first dental visit, and remineralization of the early carious lesions.

Confidence and Attitudes

The subjects' confidence in their ability to provide oral health service was low at pre-intervention. However, in the post-intervention survey, there was significant improvement in their overall level of confidence (see Table 3, mean [median] sum of scores=7.8 (7.0) and 14.1 (13.5), respectively, out of twenty questions answered before and after the intervention, $p<0.001$). A significant improvement was also noted in the participants' responses to each question in the confidence section in the post-intervention survey (Bhapkar test, $p<0.01$).

In the pre-intervention survey, most participants demonstrated an overall positive attitude toward providing oral health services during well-child visits. Only five participants did not

agree about providing dental referrals for infants by age one. Nevertheless, a significant improvement in participant scores overall was evidenced in the post-intervention responses (Wilcoxon signed-rank test, $p < 0.01$). There were no significant improvements in participants' attitudes toward incorporating counseling about dental prevention and prescribing fluoride supplements ($p > 0.49$) into the well-child visits.

Behaviors in Providing Oral Health Service

Because the participants were at the didactic phase of their education during the pre-intervention survey with no chance of participating in clinical practice at that time, their behavior regarding oral health care was only evaluated in the post-intervention survey. Eighty-three percent of the participants stated that they had performed more than ten dental examinations during their routine well-child visits (Table 3), a response that was well mirrored in the number of routine well-child visits reported by the participants. In addition, the majority of the participants reported that they frequently or always inquired about the feeding habits of the children and emphasized the importance of regular dental visits during their routine well-child examinations although fewer than half of the participants reported that they frequently or always made a dental referral for high-risk patients.

Assessment of the need for and prescription of fluoride supplements or consultation on the use of fluoride toothpastes was not done frequently by more than two-thirds of the participants. The participants reported that they very rarely inquired about the parents' oral health during their routine well-child examinations (Table 3). All of the participants reported having applied fluoride varnish in between zero and ten cases, indicating that few, if any, fluoride varnish applications were performed by participants. The participants' descriptive answers revealed that fluoride varnish had not been available in the clinics where they had practiced.

Discussion

Our study focused on evaluating the effectiveness of an interdisciplinary oral health educational program, including didactic education, simulation exercises, and clinical observation of a pediatric dentist, delivered to pediatric nurse practitioner students on their knowledge, confidence, attitudes, and behaviors regarding the incorporation of oral health assessments, consultations, preventive treatments, and referral services during routine well-child visits. First, we assessed the students' previous oral health educational experiences, knowledge, confidence, and attitudes about oral health care before they received the intervention. Interestingly, only 20 percent of the group reported that they had received any oral health education in the past, which is considerably lower than 65 percent reported for pediatric residents.²⁶ Our study showed that although the participants had adequate knowledge of some aspects of oral health care, such as cariogenic feeding habits and the role of fluoride in caries prevention, a significant number of them lacked knowledge in several important aspects, such as the recommendation of children having their first dental visit by age one, the hazardous effect of fluoride ingestion, and the fact that non-dental health care providers could be reimbursed for fluoride varnish application. These areas of lack of

knowledge about oral health care are similar to the findings in previous studies of primary pediatric providers or pediatric residents.^{19,27,28,34}

It was not surprising to find that the majority of the participants were not confident in providing oral health assessments, consultations, preventive treatments, and referrals, although almost all had positive attitudes and were willing to provide these services during their practice. These findings also agreed with those of previous studies of pediatric residents, medical students, pediatric primary care providers, and pediatric nurse practitioners.²³⁻²⁶ As reported in other studies, lack of knowledge and confidence may act as barriers to prevent pediatric primary care providers from providing oral health care services to young children.^{19,27,28,34} All participants in our study indicated that they were planning to work in a primary care hospital or specialty clinic after graduation. Adequate oral health education for these students will enable them to provide efficient oral health consultations, preventive services, and proper referrals after graduation as well as boost the workforce of pediatric medical providers who are competent in providing oral health care services to young children.

In the post-intervention survey, we observed a significant improvement in the students' knowledge, confidence, attitudes, and behaviors concerning oral health care. More than 85 percent of the subjects correctly answered eight out of thirteen knowledge questions, including those in areas such as reimbursements to non-dental health care providers for administering fluoride varnish treatments, maternal transmission of caries-causing bacteria, the preventive effects of xylitol use, the side effects of fluoride ingestion, and the benefits of having young children brush their teeth with fluoride toothpaste. Since the post-intervention survey was conducted between five and nine months after the students had completed the training course, the findings suggest that they retained the knowledge gained during their education. There was also a significant (81 percent) increase in the average sum of the students' scores that measured their confidence in their ability to advise parents about their children's oral health. The students' level of confidence nearly doubled after they participated in the intervention. Significant improvement was also evident in their attitudes toward incorporating oral health care services during routine well-child visits, even though the majority had already indicated in the pre-intervention surveys that they had positive attitudes about these practices.

The most exciting result was the finding that 83 percent of the participants reported actively incorporating oral health service as a part of their routine well-child visits. A majority of the participants (about 80 percent) frequently inquired about children's feeding habits and discussed the importance of regular dental visits with parents during the well-child examinations. This result suggests that, with adequate knowledge and confidence, the majority of the participants would be motivated and would apply their knowledge of oral health care to provide oral health assessments, consultations, preventive treatments, and referrals for children during routine well-child visits. The provision of these services by pediatric nurse practitioners could enhance the workforce to improve oral health care to young children, especially to those who do not have a dental home but have an established medical home.

Despite the significant overall improvement in participants' knowledge and confidence in oral health care, we still observed areas of weakness at post-intervention. Between 40 and 57 percent incorrectly answered questions about mechanism of fluoride use in caries prevention or timing of a child's first tooth eruption. These weak areas were consistent with the areas in which respondents were less confident. Lack of knowledge and confidence in these areas may also explain the low number of participants who included the assessment and prescription of fluoride supplements and consultation on fluoride toothpaste use in children during the well-child exam. These weak areas of knowledge were similar to those reported in two other studies on pediatric dental residents.^{19,27} Future studies should incorporate mechanisms to specifically generate feedback from students about these areas in order to seek effective ways to strengthen and improve curriculum content.

It was disappointing to find that despite the significant amount of knowledge and the enthusiasm gained regarding fluoride varnish treatment and its benefits for oral health, very few if any of the participants were able to apply fluoride varnish during their practice because it was not available in the clinic where they practiced. An organizational change to support and encourage fluoride varnish application at all pediatric clinic settings is necessary, so that clinicians can provide this important preventive dental service.

There were some limitations in the study. One limitation was the absence of a control group. Due to our limited resources, we could not identify enough subjects to have a control group. It also would have been unethical not to provide the educational intervention considered part of their curriculum to some of the students. Schaff-Blass et al. attempted to compare the effectiveness of an oral health educational intervention at the University of North Carolina with the other pediatric residency programs located nearby as control groups.²⁸ They were unable to make a justified comparison of their program to the other programs due to poor follow-up of the neighboring schools control groups. Therefore, future studies will need proper collaboration with similar pediatric nurse practitioner programs to identify a large enough study population to serve as controls and to ensure proper administration and follow-ups of surveys. Also, our study's reliance on participants' self-reporting on their practice habits may have introduced some reporting bias. Future studies using objective measurements of actual oral health care services provided with treatment codes would greatly enhance the validity of the study.

In summary, our study demonstrated that incorporating an interdisciplinary, multifaceted oral health educational curriculum in a pediatric nurse practitioner program can successfully improve students' knowledge, confidence, and attitudes regarding the inclusion of oral health assessments, consultations, preventive treatments, and referrals during routine well-child visits, with 83 percent of our participants reporting actively incorporating oral health service as a part of their routine well-child visits. These results are consistent with the successes of two other multidisciplinary educational programs in improving the knowledge, confidence, attitudes, and behaviors of pediatric residents reported by Schaff-Blassa et al. and Mouradian et al.^{19,28} Interdisciplinary education between the pediatric dental and medical education programs should be the model of future education for pediatric primary care providers and can play an important role in improving oral health in children.

The oral health education program has now been established for the pediatric nurse practitioner program at UCSF, and we are hoping this project will lead to formal collaboration on interprofessional education between the two departments. The pediatric nurse practitioners trained at UCSF's School of Nursing may work in different settings and use their oral health skills in each of these places. Hopefully, the oral health assessment will be part of their primary care work.

Conclusions

Our study investigated whether an interdisciplinary oral health educational curriculum that included didactic education, simulation exercises, and observation in a pediatric dental clinic delivered to pediatric nurse practitioner students at UCSF would improve their knowledge, confidence, attitudes, and behaviors in providing oral health assessments, consultations, referrals, and services to young children during well-child visits. The pre-intervention survey results clearly demonstrated the students' lack of knowledge and lack of confidence to provide oral health care services, although the majority had positive attitudes about providing the services. The results demonstrated that incorporating this curriculum into the program had successfully improved the students' knowledge, confidence, and attitudes concerning the incorporation of oral health services during their routine well-child visits, with 83 percent of the participants reporting actively including oral health service in their well-child visits. Incorporation of an oral health education program into the curriculum of pediatric nurse practitioner programs could help to increase the workforce for oral health care services to young children, especially those who do not have access to an established dental home.

Acknowledgment

Dr. Cheng's work was supported by Grant U54 DE019285 from the National Institute of Dental and Craniofacial Research, National Institutes of Health.

REFERENCES

1. Beltran-Aguilar ED, Barker LK, Canto MT, Dye BA, Gooch BF, Griffin SO, et al. Surveillance for dental caries, dental sealants, tooth retention, edentulism, and enamel fluorosis, United States, 1988-94 and 1999-2002. *MMWR Surveill Summ.* 2005; 54(3):1-43. [PubMed: 16121123]
2. Oral health in America: a report of the surgeon general. *J Calif Dent Assoc.* 2000; 28(9):685-695. [PubMed: 11324049]
3. Adams PF, Hendershot GE, Marano MA. Current estimates from the National Health Interview Survey, 1996. *Vital Health Stat.* 1999; 10(200):1-203.
4. Douglass JM, Tinanoff N, Tang JM, Altman DS. Dental caries patterns and oral health behaviors in Arizona infants and toddlers. *Community Dent Oral Epidemiol.* 2001; 29(1):14-22. [PubMed: 11153558]
5. Soderling EM. Xylitol, mutans streptococci, and dental plaque. *Adv Dent Res.* 2009; 21(1):74-78. [PubMed: 19717413]
6. Soderling E, Isokangas P, Pienihakkinen K, Tenovuo J, Alanen P. Influence of maternal xylitol consumption on mother-child transmission of mutans streptococci: 6-year follow-up. *Caries Res.* 2001; 35(3):173-177. [PubMed: 11385196]
7. Savage MF, Lee JY, Kotch JB, Vann WF Jr. Early preventive dental visits: effects on subsequent utilization and costs. *Pediatrics.* 2004; 114(4):e418-e423. [PubMed: 15466066]

8. Minah G, Lin C, Coors S, Rambob I, Tinanoff N, Grossman LK. Evaluation of an early childhood caries prevention program at an urban pediatric clinic. *Pediatr Dent*. 2008; 30(6):499–504. [PubMed: 19186776]
9. Weinstein P, Harrison R, Benton T. Motivating mothers to prevent caries: confirming the beneficial effect of counseling. *J Am Dent Assoc*. 2006; 137(6):789–793. [PubMed: 16803808]
10. Wawrzyniak MN, Boulter S, Giotopoulos C, Zivitski J. Incorporating caries prevention into the well-child visit in a family medicine residency. *Fam Med*. 2006; 38(2):90–92. [PubMed: 16450227]
11. Guideline on infant oral health care. *Pediatr Dent*. 2008; 30(7 Suppl):90–93. [PubMed: 19216404]
12. Schroth RJ, Cheba V. Determining the prevalence and risk factors for early childhood caries in a community dental health clinic. *Pediatr Dent*. 2007; 29(5):387–396. [PubMed: 18027773]
13. Malik-Kotru G, Kirchner L, Kisby L. An analysis of the first dental visits in a federally qualified health center in a socioeconomically deprived area. *J Clin Pediatr Dent*. 2009; 33(3):265–268. [PubMed: 19476104]
14. Slayton RL, Warren JJ, Levy SM, Kanellis MJ, Islam M. Frequency of reported dental visits and professional fluoride applications in a cohort of children followed from birth to age 3 years. *Pediatr Dent*. 2002; 24(1):64–68. [PubMed: 11874064]
15. Lee JY, Bouwens TJ, Savage MF, Vann WF Jr. Examining the cost-effectiveness of early dental visits. *Pediatr Dent*. 2006; 28(2):102–105. discussion 92–8. [PubMed: 16708783]
16. American Academy of Pediatric Dentistry. Policy on workforce issues and delivery of oral health care services in a dental home. *J Pediatr Dent*. 2011; 33(6):27–30.
17. Beil HA, Rozier RG. Primary health care providers' advice for a dental checkup and dental use in children. *Pediatrics*. 2010; 126(2):e435–e441. [PubMed: 20660547]
18. Bethell CD, Kogan MD, Strickland BB, Schor EL, Robertson J, Newacheck PW. A national and state profile of leading health problems and health care quality for U.S. children: key insurance disparities and across-state variations. *Acad Pediatr*. 2011; 11(3 Suppl):S22–S33. [PubMed: 21570014]
19. Mouradian WE, Schaad DC, Kim S, Leggott PJ, Domoto PS, Maier R, et al. Addressing disparities in children's oral health: a dental-medical partnership to train family practice residents. *J Dent Educ*. 2003; 67(8):886–895. [PubMed: 12959162]
20. American Academy of Pediatrics. Recommendations for preventive pediatric health care. Washington, DC: American Academy of Pediatrics; 2008.
21. Silver HK, Ford LC, Stearly SG. A program to increase health care for children: the pediatric nurse practitioner program. *Pediatrics*. 1967; 39(5):756–760. [PubMed: 6026876]
22. National Association of Pediatric Nurse Practitioners. [Accessed: April 8, 2012] Pediatric nurse practitioner school list. At: www.napnap.org/forstudents/pnpschoollisting.aspx
23. Bay RDJDC. Oral health competencies for physician assistants and nurse practitioners. *J Physician Assistant Educ*. 2006; 17(4):12–16.
24. Krol DM. Educating pediatricians on children's oral health: past, present, and future. *Pediatrics*. 2004; 113(5):e487–e492. [PubMed: 15121992]
25. Freed GL, Dunham KM, Switalski KE, Jones MD Jr, McGuinness GA. Recently trained general pediatricians: perspectives on residency training and scope of practice. *Pediatrics*. 2009; 123(Suppl 1):S38–S43. [PubMed: 19088244]
26. Caspary G, Krol DM, Boulter S, Keels MA, Romano-Clarke G. Perceptions of oral health training and attitudes toward performing oral health screenings among graduating pediatric residents. *Pediatrics*. 2008; 122(2):e465–e471. [PubMed: 18676532]
27. Douglass JM, Douglass AB, Silk HJ. Infant oral health education for pediatric and family practice residents. *Pediatr Dent*. 2005; 27(4):284–291. [PubMed: 16317967]
28. Schaff-Blass E, Rozier RG, Chattopadhyay A, Quinonez R, Vann WF Jr. Effectiveness of an educational intervention in oral health for pediatric residents. *Ambul Pediatr*. 2006; 6(3):157–164. [PubMed: 16713934]
29. American Academy of Pediatrics. [Accessed: April 8, 2012] Oral health initiative. At: www.aap.org/oralhealth/links-training.cfm

30. California Dental Association Foundation. [Accessed: April 8, 2012] First smiles. At: www.cdafoundation.org/learn/first_smiles_education_and_training_program
31. Douglass, JM. Knee-to-knee positioning: smiles for life (STFM). Farmington: University of Connecticut School of Dental Medicine; 2007.
32. McNemar Q. Note on the sampling error of the difference between correlated proportions or percentages. *Psychometrika*. 1947; 12(2):153–157. [PubMed: 20254758]
33. Bhapkar VP. A note on the equivalence of two test criteria for hypotheses in categorical data. *J Am Statistical Assoc*. 1966; 61:228–235.
34. Hallas D, Shelley D. Role of pediatric nurse practitioners in oral health care. *Acad Pediatr*. 2009; 9(6):462–466. [PubMed: 19945081]

Table 1

Demographics, experience, and working plans of pediatric nurse practitioner students in study, by number and percentage of total participants (n=30)

	Number (%)
Age	
25 years or younger	3 (10%)
26–30 years	18 (60%)
31–35 years	3 (10%)
36 years or older	6 (20%)
Gender	
Female	28 (93%)
Male	2 (7%)
Years of experience prior to the study	
No experience	3 (10%)
1–6 years	21 (70%)
7 years or more	6 (20%)
Future working plan after graduation	
Primary care clinic	17 (57%)
Hospital or specialty clinic	13 (43%)
Prior formal oral health education	
Yes	6 (20%)
No	24 (80%)

Table 2

Oral health knowledge of pediatric nurse practitioners in study before and after oral health educational intervention

Questions	Total Number	Pre-Test		Post-Test		p-value*
		Number Correct	Percentage	Number Correct	Percentage	
1. On average a child's first tooth erupts between 9 months and 1 year of age.	30	13	43%	17	57%	0.344
2. The bacteria that cause dental decay can be transmitted from mother to child.	30	26	87%	30	100%	0.219
3. Xylitol is a carbohydrate that is not fermentable by oral bacteria.	29	18	62%	25	86%	0.065
4. Xylitol is a sugar substitute that has been shown to kill the oral bacteria that cause cavities.	28	18	64%	24	90%	0.109
5. Fluoride prevents tooth decay by making the teeth stronger.	30	26	87%	27	90%	1.000
6. Ingesting fluoride while the teeth are forming (before eruption) helps prevent tooth decay.	30	20	67%	12	40%	0.077
7. Toothpaste containing fluoride should not be used to brush a 3-year-old child's teeth due to the risk of fluorosis.	30	12	40%	10	33%	0.791
8. Fluoride prevents tooth decay when applied topically to the surfaces of teeth.	30	27	90%	28	93%	1.000
9. Non-dental health professionals can be reimbursed for fluoride varnish applications.	30	19	63%	30	100%	0.003
10. A child's first dental exam should occur by 3 years of age or when all primary teeth have completed eruption.	30	14	47%	12	40%	0.754
11. Chalky white spots on a child's teeth can be remineralized with fluoride varnish.	30	13	43%	18	60%	0.302
12. Infants should not be put to bed with a bottle of juice or milk.	30	29	97%	30	100%	1.000
13. Frequent snacking with carbohydrates increases the risk of developing early childhood caries.	30	30	100%	30	100%	1.000
Sum of scores		Mean (SD) 8.9 (1.86)	Median 9.0	Mean (SD) 10.4 (1.3)	Median 10.0	p-value** <0.0001

* Exact McNemar's test was used to compare oral health knowledge in the pre- and post-intervention surveys for each individual question.

** Wilcoxon signed-rank test was used to compare overall change in sum of scores of oral health knowledge in the pre- and post-intervention surveys.

Table 3

Confidence, attitudes, and behavior of pediatric nurse practitioners in study about providing oral health service measured before and after health educational intervention, by number and percentage of total participants (n=30)

Confidence Questions	Pre-Intervention					Post-Intervention					p-value*
	Very Confident	Slightly Confident	Not Confident	Very Confident	Slightly Confident	Not Confident	Very Confident	Slightly Confident	Not Confident		
Consult on child's oral hygiene	8 (27%)	19 (63%)	3 (10%)	17 (57%)	13 (43%)	0					<0.005
Consult on water fluoridation	3 (10%)	9 (31%)	17 (59%)	6 (21%)	23 (79%)	0					<0.0001
Dietary consult on caries prevention	8 (27%)	19 (63%)	3 (10%)	24 (80%)	6 (20%)	0					<0.0005
Consult on fluoride supplement in infancy	2 (7%)	8 (27%)	20 (66%)	9 (30%)	20 (67%)	1 (3%)					<0.0005
Consult on dental visits in infancy/childhood	5 (17%)	19 (63%)	6 (20%)	23 (77%)	7 (23%)	0					<0.0005
Perform oral exam on infants and toddlers	3 (10%)	13 (43%)	14 (47%)	8 (27%)	22 (73%)	0					<0.001
Identify early childhood tooth decay	3 (10%)	13 (43%)	14 (47%)	8 (27%)	21 (70%)	1 (3%)					<0.005
Identify other signs of oral pathology	0	14 (37%)	16 (53%)	5 (17%)	18 (60%)	7 (23%)					<0.01
Evaluating risk of tooth decay in infants and toddlers	3 (10%)	19 (63%)	8 (27%)	12 (40%)	18 (60%)	0					<0.0005
Refer a child to a dentist	3 (10%)	19 (63%)	8 (27%)	12 (40%)	18 (60%)	0					<0.0005
Sum of scores	Mean (SD) 7.8 (4.1)	Median 7.0		Mean (SD) 14.1 (2.8)	Median 13.5						p-value** <0.0001

Attitude Questions	Pre-Intervention					Post-Intervention					p-value*
	Strongly Agree	Agree	Disagree	Strongly Disagree	Strongly Agree	Agree	Disagree	Strongly Disagree			
Assess early signs of dental problems during the physical exam	15 (50%)	15 (50%)	0	0	25 (83%)	5 (17%)	0	0			0.06
Refer children aged 1 to a dentist	10 (33%)	15 (50%)	5 (17%)	0	21 (70%)	7 (23%)	2 (7%)	0			0.06
Consult on dental preventions	16 (53%)	14 (47%)	0	0	21 (70%)	9 (30%)	0	0			0.49
Prescription of fluoride supplements	15 (50%)	15 (50%)	0	0	20 (67%)	10 (33%)	0	0			0.57
Sum of scores	Mean (SD) 9.7 (1.8)	Median 10.0			Mean (SD) 10.8 (1.6)	Median 11.5					p-value** 0.0057

Behavior Questions	Post-Intervention				
	0-10 Cases	11-20 Cases	21-30 Cases	31-40 Cases	>40 Cases
Number routine physical exams over past 3 months	7 (23%)	10(33%)	8 (27%)	3(10%)	2 (7%)
Number oral exams in past 3 months	5(17%)	10(33%)	8 (27%)	3(10%)	4(13%)
Number fluoride varnishes applied in past 3 months	30(100%)	0	0	0	0
How often performed the following tasks during a routine exam over past 3 months:	Always	Frequently	Occasionally	Rarely	Never
•Assess a child's fluoride intake for the need of supplementation	1 (3%)	8 (27%)	6 (20%)	7 (23%)	8 (27%)
•Prescribe fluoride supplements	0	5(17%)	2 (7%)	5(17%)	18(60%)
•Discuss fluoride toothpaste use with parents	4(13%)	6 (20%)	9 (30%)	3(10%)	8 (27%)
•Inquire about a child's use of a bottle in bed	12(40%)	13(43%)	5(17%)	0	0
•Counsel parents on the importance of regular dental visits	11 (37%)	12(40%)	5(17%)	0	2 (7%)
•Inquire about mother's dental health	1 (3%)	2 (7%)	5(17%)	14(37%)	8 (27%)
•Refer high-risk patients to a dentist	5(17%)	6 (20%)	5(17%)	4(13%)	10(33%)

* Bhapkar test was used for pre and post comparison for each individual question.

** Wilcoxon signed-rank test was used to compare overall change in sum of scores in the pre- and post-intervention surveys.